Cardiac device inducted into Space Hall of Fame

Money invested in space research continues to result in technological spin-offs that benefit people here on Earth. Air bag sensors, dental x-rays, heart pumps, and a portable heart-shocking device are among the latest technologies originally developed for space that are now used in everyday life.

The tiny heart pump, developed by NASA, was inducted into the Space Technology Hall of Fame by the United States Space Foundation during a special awards reception held recently in Colorado Springs, Colo. Receiving Hall of Fame medals for their role in the pump development were Dr. Michael DeBakey, chancellor emeritus of the Baylor College of Medicine and director of the DeBakey Heart Center at Baylor and the Methodist Hospital; Bernard Rosenbaum of JSC's Engineering Directorate; retired JSC employees James Akkerman, Richard Bozeman Jr., and Paul Svejkovsky; former JSC employee Gregory Aber; Dr. Cetin Kiris and Dr. Dochan Kwak of Ames Research Center; James Bacak of Lockheed Engineering and Sciences Co.; Dr. George Noon and Dr. H. David Short of the Baylor College of Medicine; and George Damm and Robert Benkowski, formerly with Baylor College of Medicine.

The U. S. Space Foundation also awarded an individual Space Technology Hall of Fame medal to Dallas Anderson, president of MicroMed Technology, for his contribution to commercializing the pump.

"The blood pump project is a good example of NASA's Technology Transfer and Commercialization Program," said Robert Dotts, assistant director of JSC's Technology Transfer and Commercialization Office. "Technology developed by NASA for the space program is used in a cooperative activity between NASA and a university medical center with NASA patents on the resulting technology. NASA's marketing activity culminates in a license to a local startup company that is successful in developing the device and its market, thus enabling improvement in the quality of and the saving of many lives."

JSC Director George Abbey submitted the nomination for the award in recognition of using NASA-developed technology for commercial applications. The ingenuity of the NASA-contractor design team and such tools as the Computational Fluid Dynamic (CFD) software developed to help avoid cavitation in the shuttle's turbopumps were used to help solve cavitation and flow stagnation problems that damage sensitive blood cells and allow clot formations in competing devices.

The pump, called the DeBakey VAD™ (ventricular assist device), is no bigger than two AA batteries, one-tenth the size of portable heart-assist devices now on the market.

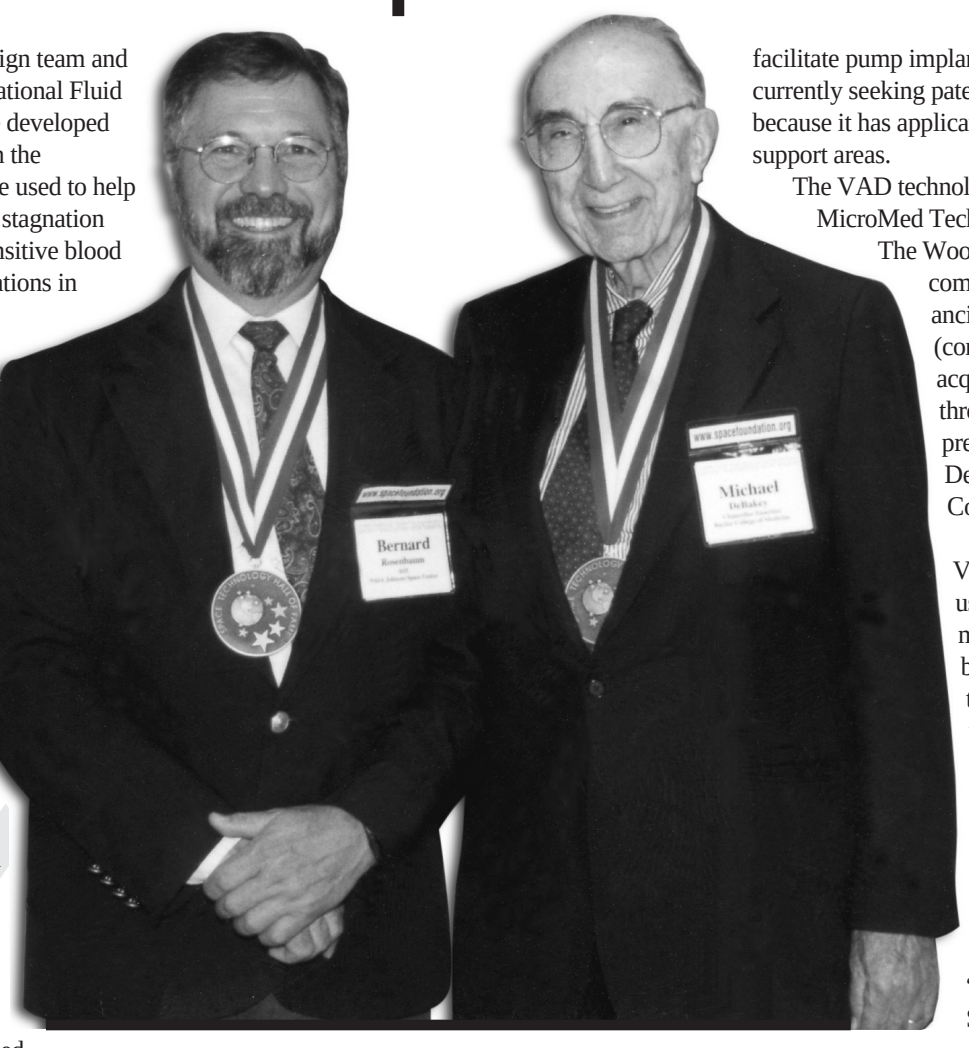
The task of developing the pump proved rather challenging, requiring a broad range of skills from both the NASA team and DeBakey and his medical staff at the Baylor College of Medicine, culminating in the successful implementations of the VAD. NASA engineers developed designs for both the electrical and the hydrodynamics aspects of the pump, motor, and the control electronics. Of notable importance, the integrated assembly has only the single moving part (rotor) and has no shaft seals to cause leakage or wear-out problems. Additionally, the pump's small size is well suited for implantation, including into children.

The fluid pumping aspect of the VAD proved to be only the first part of the challenge; the next was solving the two-part problem that had long plagued the medical community, that of damage to delicate blood cells during pumping (hemolysis) and the formation of blood clots (thrombus) in mechanical parts. This is where the CFD modeling software initially developed for the shuttle's turbopumps became a very useful design tool.

Iterative CFD runs could quickly model blood flow patterns in specific areas of the pump. This was particularly true of the small nooks and crannies of the bearing cavities where slight stagnant flow could lead to thrombus formation. CFD also helped identify areas of high shear and unstable flow that could contribute to cell damage and to evaluate if proposed design solutions had more favorable flow patterns. NASA design skills also were used to develop the attachment technique that permitted the pump outflow cannula to be a leak-free yet separable connection to facilitate pump implantation. NASA is currently seeking patent status on this design because it has applications in other medical support areas.

The VAD technology was licensed to MicroMed Technology, Inc. based in The Woodlands, Texas. The company developed the ancillary support systems (controller and data acquisition systems) through a series of preclinical trials with DeBakey at Baylor College of Medicine.

The assistance the VAD provides will be used in three distinct modes. Initially it will be used as a "bridge to transplant" – as a temporary device to help the patient survive while waiting for a suitable transplant organ to become available. A second beneficial application is as a "bridge to recovery." Surgeons have discovered that with some hearts, the assistance supplied by the pump is sufficient to allow the natural heart to repair itself; in which case, the pump can later be removed. The third anticipated application is as a permanent implant. ■



Hall of Fame medal recipients Bernard Rosenbaum, left, and Dr. Michael DeBakey.

VAD UPDATE — Following approval by the Freiburg (Germany) ethics commission to begin clinical trials, the VAD was, for the first time, on Nov. 13, 1998, successfully implanted in the chest of a 56-year-old patient at the German Heart Institute in Berlin by heart surgeons monitored by Dr. Michael DeBakey. Ten patients have been implanted to date; five of them have already gone to heart transplant.

Flores is NASA's medical front line in Moscow

It's a little like being a country doctor, but there are some pretty significant differences. Dr. Jose F. Flores, NASA support physician – Russia, has to be not only a physician but also a medical diplomat and medical counselor, among other things.

Flores is trained in internal medicine, endocrinology and aerospace medicine. He is the medical front line – his job is to provide medical care for the NASA and contractor people assigned to Russia and their dependents.

He also works 30 hours a week (three 10-hour shifts) at the International Medical Clinic in Moscow, a modern facility where many westerners seek treatment. In addition to western physicians, it has a Russian medical staff, and also treats Russians.

Mike Baker, JSC assistant director for Human Space Flight Programs in Russia, heads NASA activities in that country. He said Flores' work at the IMC is essentially a tradeoff. Flores works at the IMC in return for the facilities being made available to NASA and contractor personnel at a reduced price. NASA people must pay for its services, but can claim insurance reimbursement.

One advantage of his work at the IMC is simply being wired in to the local medical community. "You learn how to get tests done here, how to get X-rays - where things can be sent. That way, when we do have a more significant problem with a NASA person, I've already made my connections."

Dr. Jose F. Flores

Flores, who works for NASA under a Kelsey-Seybold Clinic contract, sees a lot of NASA/contractor patients at the Volga, an apartment/hotel north of downtown Moscow where the agency leases 40 units. His hours there are irregular.

The colds and flu can be dealt with at the apartment. "If things are a little more serious, I ask them to come to the IMC."

Those more complex medical problems, problems that might be handled reasonably easily in the United States, can be more challenging in Moscow.

"Say you have a patient come in with a head injury on a Saturday night," Flores said. "Here you might have to figure out how you can get a CAT scan done – so it's not as simple. You have to learn to deal with the Russian medical system." Diplomacy is required.

So too is greater wariness. "I think you tend to be a little more cautious here. It's a much bigger problem if you need a hospital." That could involve an admission to a Russian hospital, observation at the IMC or a medical evacuation out of Russia, he said.

In a Russian hospital, control of the patient technically belongs to the staff physicians. That could be a difficult situation for a patient accustomed to western doctors, medicines and medical equipment.

"When I came to Russia, I didn't expect to see the range of medical problems I've encountered. Most are common, some are funny and some are complex and life-threatening," he said.

Like the country doctor, "You feel like you're it - the one who has to deal with a particular medical problem."

In Moscow it is more difficult than in the west to refer a patient to a medical specialist. "I often call back to Houston to talk to Kelsey-Seybold specialists or to JSC Flight Medicine to discuss more complex problems," Flores said. "Sometimes I call my old medical school and residency buddies."

Flores has been in Moscow about six months. His contract is for a year, but it is likely that he will stay longer. "It's a fascinating place," he said, "and a fascinating place to practice medicine." ■